

Assignment 17.4. Questions #64, 77, 79, 84, 86, 88, 92, 95

64) $E = E^\circ - \frac{0.0592}{n} \log Q$ $Q = \frac{[Ag^+]_{\text{anode}}}{[Ag^+]_{\text{cathode}}}$

$0.76 = -0.0592 \log Q$ $1.45 \times 10^{-13} = \frac{[Ag^+]_{\text{anode}}}{0.10 \text{ M}}$

$Q = 1.45 \times 10^{-13}$ $[Ag^+]_{\text{anode}} = 1.5 \times 10^{-14} \text{ M}$

b. $Ag^+(aq) + 2 S_2O_3^{2-}(aq) \rightleftharpoons Ag(S_2O_3)_2^{3-}(aq)$

$K = \frac{[Ag(S_2O_3)_2^{3-}]}{[Ag^+][S_2O_3^{2-}]^2} = \frac{[1.0 \times 10^{-3}]}{[1.45 \times 10^{-14}][0.050]^2} = 2.8 \times 10^{13}$

77) $\frac{1000\text{g Al}}{26.98\text{g Al}} \times \frac{1 \text{ mol Al}}{1 \text{ mol Al}} \times \frac{3 \text{ mol e}^-}{1 \text{ mol Al}} \times \frac{96,500 \text{ C}}{1 \text{ mol e}^-} \times \frac{1 \text{ s}}{100.0 \text{ C}} \times \frac{1 \text{ min}}{60 \text{ s}} \times \frac{1 \text{ hr}}{60 \text{ min}} = 30. \text{ hr}$

$\frac{1.0\text{g Ni}}{58.69\text{g Ni}} \times \frac{1 \text{ mol Ni}}{1 \text{ mol Ni}} \times \frac{2 \text{ mol e}^-}{1 \text{ mol Ni}} \times \frac{96,500 \text{ C}}{1 \text{ mol e}^-} \times \frac{1 \text{ s}}{100.0 \text{ C}} = 33 \text{ s}$ $\leftarrow 100 \text{ A} = 100 \text{ C/s}$

$\frac{5 \text{ mol Ag}}{1 \text{ mol Ag}} \times \frac{1 \text{ mol e}^-}{1 \text{ mol e}^-} \times \frac{96,500 \text{ C}}{1 \text{ mol e}^-} \times \frac{1 \text{ s}}{100.0 \text{ C}} \times \frac{1 \text{ min}}{60 \text{ s}} = 80. \text{ min}$

79) $\frac{60. \text{ min}}{1 \text{ min}} \times \frac{60 \text{ s}}{1 \text{ s}} \times \frac{15 \text{ C}}{96,500 \text{ C}} \times \frac{1 \text{ mol e}^-}{2 \text{ mol e}^-} \times \frac{1 \text{ mol Co}}{1 \text{ mol Co}} \times \frac{58.93 \text{ g Co}}{1 \text{ mol Co}} = 16 \text{ g Co}$

$\frac{15 \text{ A} = 15 \text{ C/s}}{15 \text{ A} = 15 \text{ C/s}} \times \frac{1 \text{ mol Hf}}{4 \text{ mol e}^-} \times \frac{178.5 \text{ g Hf}}{1 \text{ mol Hf}} = 25 \text{ g Hf}$

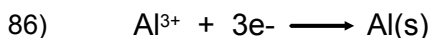
$\frac{1 \text{ mol I}_2}{2 \text{ mol e}^-} \times \frac{253.8 \text{ g I}_2}{1 \text{ mol I}_2} = 71 \text{ g I}_2$

$\frac{1 \text{ mol Cr}}{6 \text{ mol e}^-} \times \frac{52.00 \text{ g Cr}}{1 \text{ mol Cr}} = 4.8 \text{ g Cr}$

84) $2H_2O(l) \longrightarrow 2H_2(g) + O_2(g)$

$\frac{15 \text{ min}}{1 \text{ min}} \times \frac{60 \text{ s}}{1 \text{ s}} \times \frac{2.5 \text{ C}}{96,500 \text{ C}} \times \frac{1 \text{ mol e}^-}{2 \text{ mol H}_2} \times \frac{2 \text{ mol H}_2}{4 \text{ mol e}^-} \times \frac{22.4 \text{ L H}_2}{1 \text{ mol H}_2} = 0.261 \text{ L H}_2(g)$

$\frac{1 \text{ mol O}_2}{4 \text{ mol e}^-} \times \frac{22.4 \text{ L O}_2}{1 \text{ mol O}_2} = 0.131 \text{ L O}_2(g)$

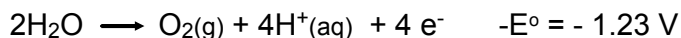


$$\frac{2000 \text{ lbs}}{2.2 \text{ lbs}} \times \frac{1 \text{ kg}}{1 \text{ kg}} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mol Al}}{26.98 \text{ g Al}} \times \frac{3 \text{ mol e}^-}{1 \text{ mol Al}} \times \frac{96,500 \text{ C}}{1 \text{ mol e}^-} = 9.75 \times 10^9 \text{ C}$$

$$\frac{24 \text{ hours}}{1 \text{ hr}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{60 \text{ s}}{1 \text{ min}} = 86,400 \text{ s} \quad I = \frac{9.75 \times 10^9 \text{ C}}{86,400 \text{ s}} = \mathbf{110,000 \text{ amps}}$$

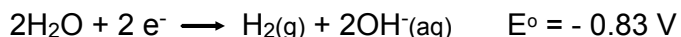
88) $\frac{0.50 \text{ L}}{1 \text{ L}} \times \frac{0.0099 \text{ mol Pt}}{1 \text{ mol Pt}} \times \frac{4 \text{ mol e}^-}{1 \text{ mol e}^-} \times \frac{96,500 \text{ C}}{4.00 \text{ C}} \times \frac{1 \text{ s}}{60 \text{ s}} \times \frac{1 \text{ min}}{60 \text{ s}} = 8.0 \text{ min}$

92a) Possible oxidation reactions:



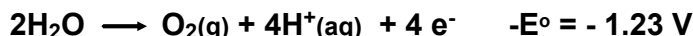
It's easier to oxidize bromine, which makes it a better anode

Possible reduction reactions:



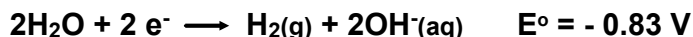
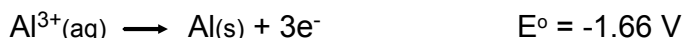
Easier to reduce nickel, which makes it a better cathode

92b) Possible oxidation reactions:



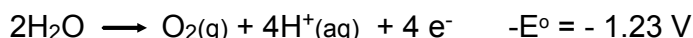
Easier to oxidize water, so oxygen will be produced at the anode.

Possible reduction reactions:



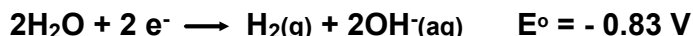
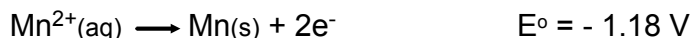
Easier to reduce water, so hydrogen will be produced at the cathode.

c) Possible oxidation reactions:

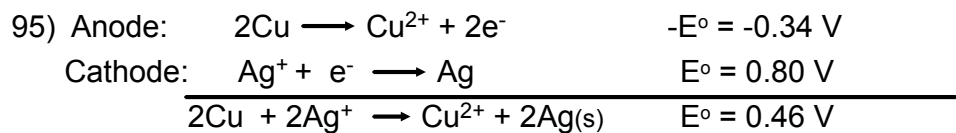


Easier to oxidize iodine, so iodine gas produced.

Possible reduction reactions:



Easier to reduce water. Hydrogen produced at the cathode.



$$Q = \frac{[\text{Cu}^{2+}]}{[\text{Ag}^+]^2} \quad E = E^\circ - \frac{0.0592}{n} \log Q$$

- As $[\text{Cu}^{2+}]$ increases, Q increases. If Q increases, E decreases.
- If NH_3 reduces $[\text{Cu}^{2+}]$, Q decreases. If Q decreases, E increases.
- If $[\text{Ag}^+]$ decreases, Q increases. If Q increases, E decreases a little.
- If both concentrations are halved, Q will increase. The dilution will affect $[\text{Ag}^+]$ more because it is squared. If Q increases, E decreases.
- Ag does not oxidize to become Ag^+ , so the platinum will not affect the cell potential. Also, solids are not in the equation for Q .